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# Recapture Training Aid

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# **Recapture Training Aid**

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## **Abstract**

The breacher's training aid described in this report was designed to simulate features of magazine and steel-plate doors. The training aid enables breachers to practice using their breaching tools on components that they may encounter when attempting to enter a facility. Two types of fixtures were designed and built: (1) a large fixture incorporates simulated hinges, hasps, lock shrouds, and pins, and (2) a small fixture simulates the cross section of magazine and steel-plate doors. The small fixture consists of steel plates on either side of a structural member, such as an I-beam. The report contains detailed descriptions and photographs of the training aids, assembly instructions, and drawings.

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# Recapture Training Aid

## Purpose

The purpose of this project was to design and field training aids for breachers to practice using their breaching tools. In particular, the breachers need a training aid that simulates features of structures they may need to recapture. The training aid must have easily replaceable parts that can be cut from raw steel material or easily fabricated at a metal shop.

The two types of doors of interest for breaching exercises are magazine doors and sliding steel-plate doors. Magazine doors are typically constructed with  $\frac{3}{8}$ -inch carbon-steel plate on the exterior and a 16-gage steel plate on the interior. Structural members such as 3-inch C-channels (C3-6) are sandwiched between the plates. To lock the magazine doors, the doors either drop down into a channel (dropdown magazine doors) or are pinned with  $1\frac{3}{8}$ -inch diameter pins that lock the doors into the base plate and header (pinned magazine doors). Each magazine door is typically 5 feet wide  $\times$  12 feet tall. Figures 1 and 2 show the dropdown and pinned magazine doors.

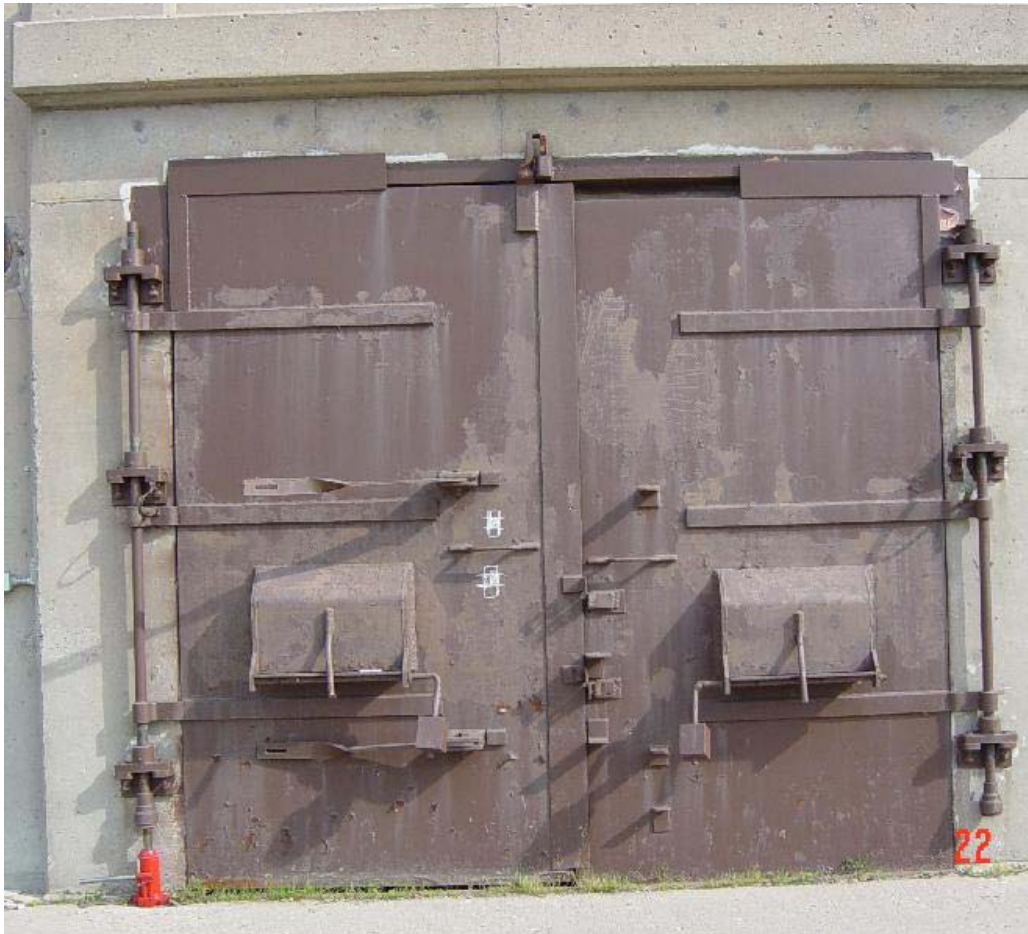


Figure 1. Dropdown magazine door



Figure 2. Pinned magazine door

Sliding steel-plate doors are constructed from steel plate on the exterior and interior sandwiching structural members. A typical door has  $\frac{5}{8}$ -inch steel plate on the outer surface, 8-inch I-beams spaced periodically—every 15-inches—followed by a  $\frac{3}{8}$ -inch steel plate on the interior. Sliding steel-plate doors can be approximately 19 feet wide and nearly 14 feet tall. They roll on trolley wheels on an I-beam mounted to the exterior wall. Figure 3 shows a typical sliding steel-plate door.

Features of interest to the breachers on the magazine doors are the hinges, hasps, locks, pins, and door faces. For the sliding steel-plate doors, desirable features to simulate are the lock shrouds and door faces with structural members between them.





Figure 3. Sliding steel-plate door

## Breaching Tools

An oxygen lance torch and a rescue saw are included in the breacher's tool kit. The oxygen lance torch uses oxygen to burn steel alloy rods at very high temperatures (approximately 10000°F). It is very effective at cutting, melting, or liquefying many materials, especially mild steel. Figure 4 shows a breacher using an oxygen lance torch. Rescue saws are commonly used to cut through metal. They can be either gas- or electric-powered. Gas-powered saws are usually more powerful and can accommodate larger diameter blades, but are heavier than the electric-powered saws. Figure 5 shows a typical a rescue saw.



Figure 4. Breacher using an oxygen lance torch

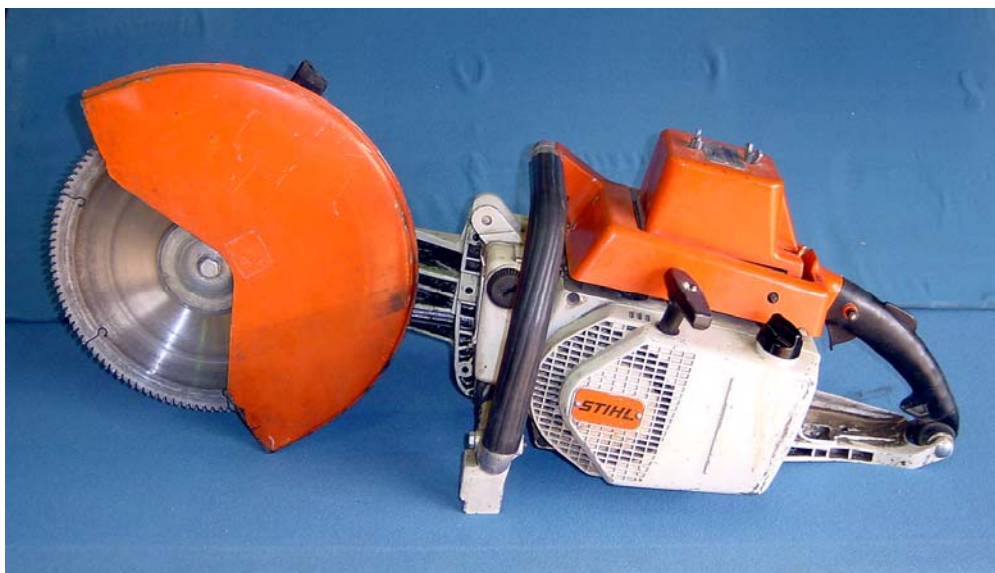


Figure 5. Gas-powered 14-inch rescue saw

## Description and Use of Training Aids

### Large Training Aid – Hinge, Hasp, Pin, and Lock Shroud Simulator

A large training aid was designed to simulate the hinges, pins, hasps and locks found on magazine doors and the lock shrouds on sliding steel-plate doors. Two prototypes were built to acquire feedback on the design. The feedback was incorporated into the design. The final design—the field unit—is the third iteration of the design. The most significant change to the large unit was to the frame and lock shroud assembly. Lighter structural materials were used (thin-gage steel box beams versus heavy C-channels), and the lock shroud assembly was simplified. As a result, the weight was reduced by 1200 pounds, and the fixture is now much easier to assemble. The large fixture measures 10 feet tall × 5 feet 1-inch wide. Figure 6 shows a drawing of the fixture. Figure 7 shows a photograph of an assembled field unit illustrated with enlargements of the door components they simulate. Table 1 lists the components and their weights. Appendix A describes the assembly instructions for each training aid. Appendix B contains detailed drawings.

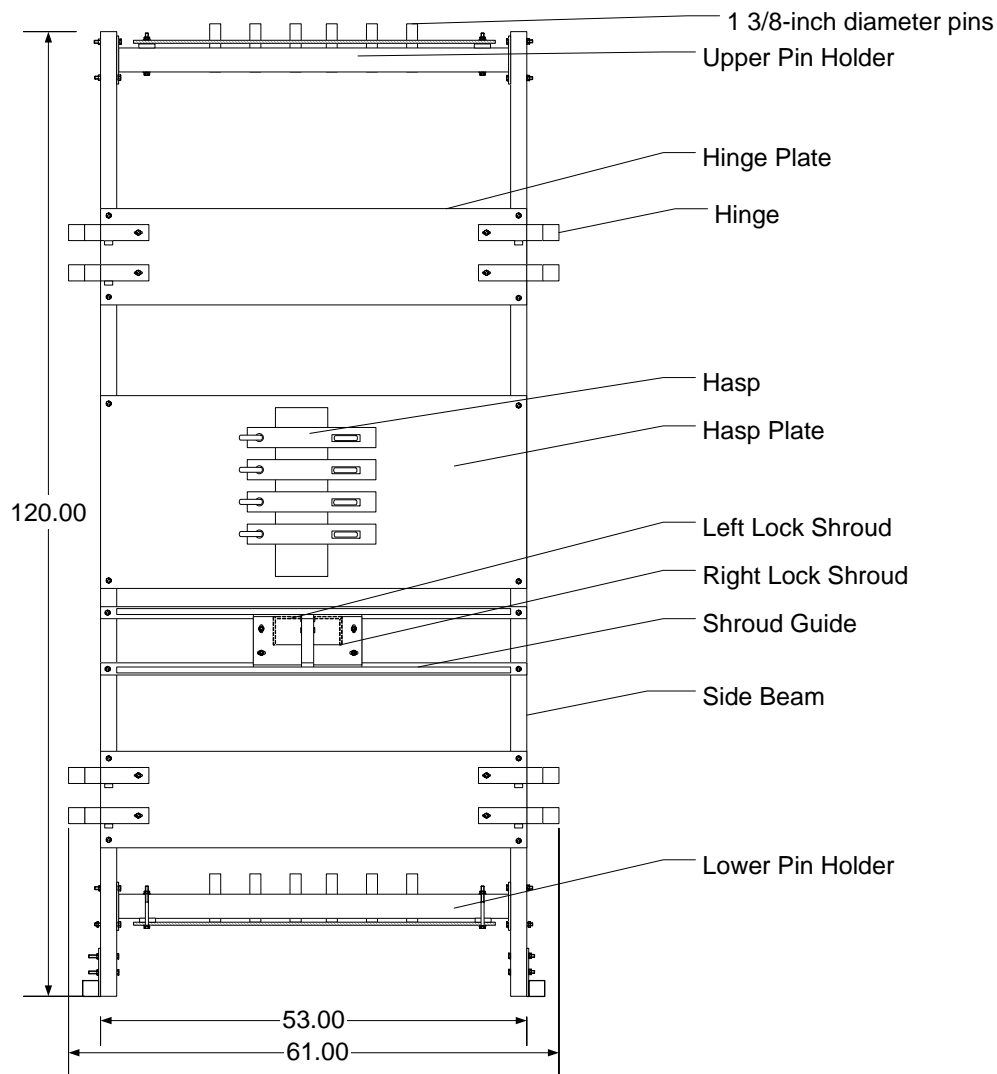


Figure 6. Large training aid

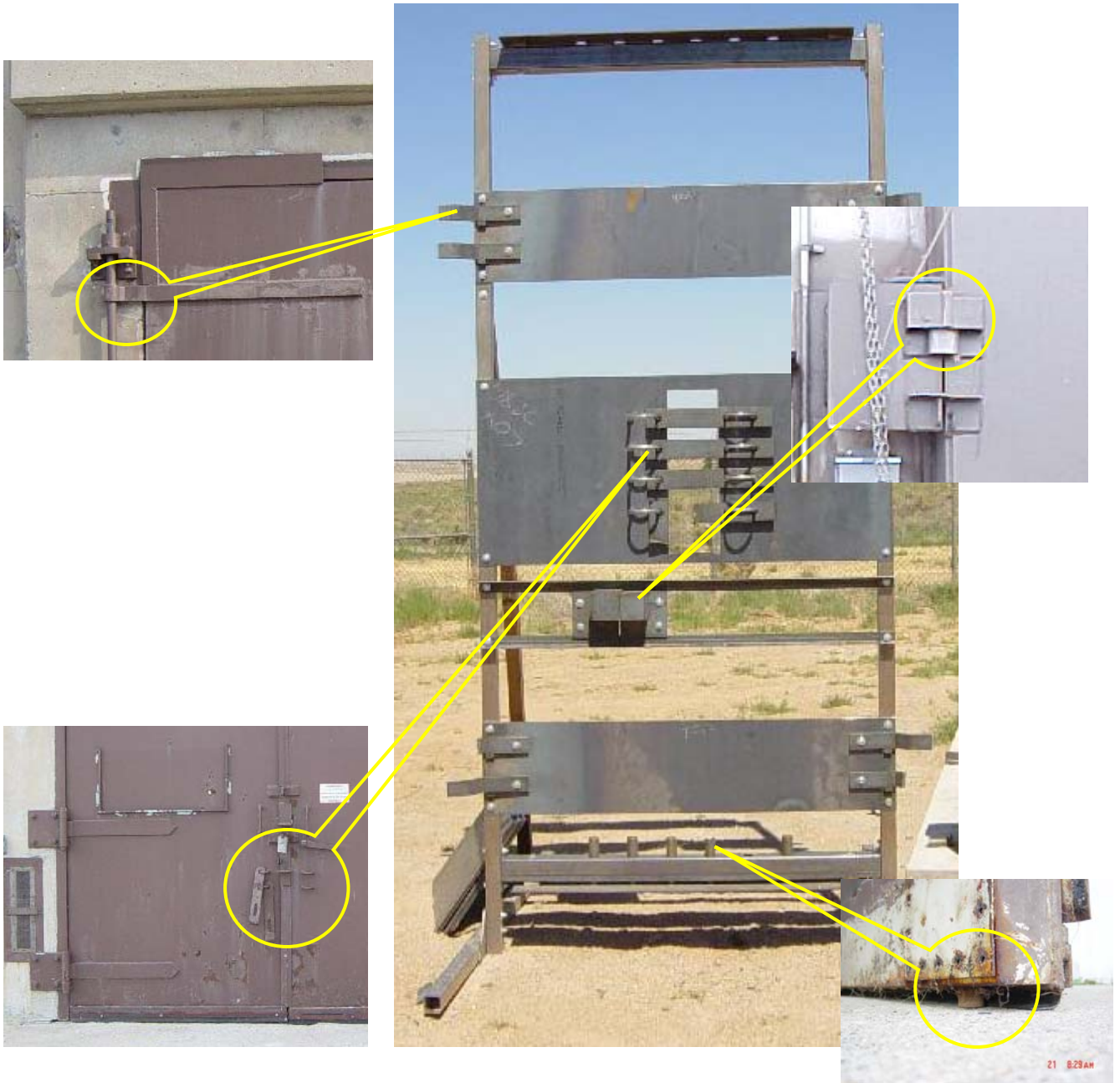


Figure 7. Assembled large field unit with photographs of components they represent

**Table 1. List of Components and Weights of Large Training Aid**

| Assembled Part                          | Weight (lb)  |
|---|--------------|
| Frame                                   | 99.1         |
| Upper Pin Holder with 6 Pins            | 61.6         |
| Lower Pin Holder with 6 Pins            | 61.6         |
| Two Hinge Plates with 4 Hinges Each     | 75.6         |
| Hasp Plate with 4 Hasps                 | 78.7         |
| Left and Right Lock Shrouds with Guides | 33.5         |
| <b>Total</b>                            | <b>410.1</b> |

### **Small Training Aid – Cross Section Simulator**

The smaller training aid simulates the faceplates and cross section of steel-plate and magazine doors. A typical magazine door has  $\frac{3}{8}$ -inch steel plate on the outside, 16-gage steel on the interior, and C-channels (e.g., C3-6) between them. Steel-plate doors are made in a variety of thicknesses. A typical exterior sliding steel plate door has  $\frac{5}{8}$ -inch steel plate on the exterior and  $\frac{3}{8}$ -inch steel plate on the interior. I-beams (e.g., S8-23) are spaced periodically between the plates.

The final field unit of the smaller training aid changed only slightly from the prototypes. The material for the legs changed from C-channels to box beams. The legs were welded to the table instead of bolted, reducing assembly time and the total number of parts. Figure 8 shows drawings of the small fixture. Figure 9 shows photographs of the small unit. Table 2 lists the component weights for the small unit.

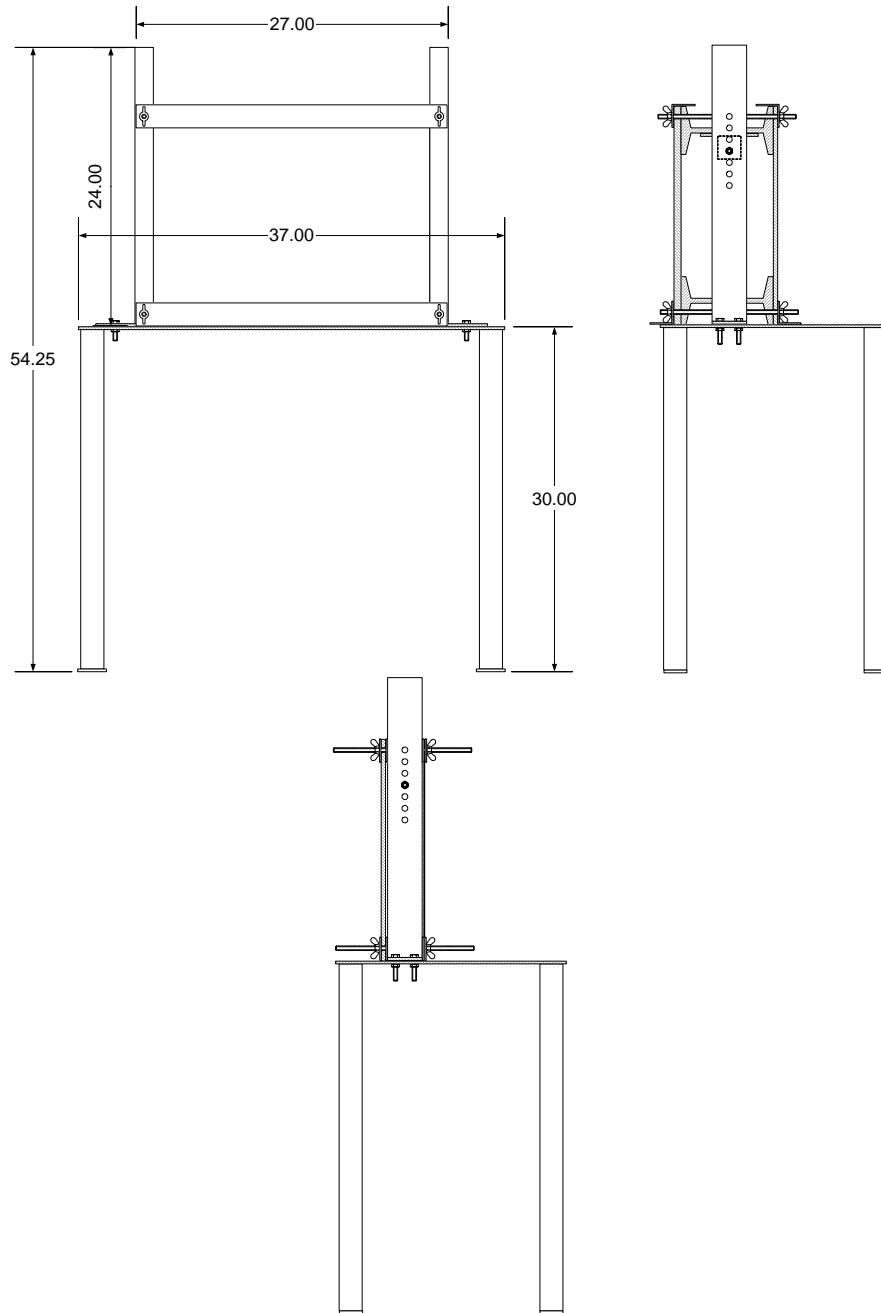


Figure 8. Small fixture simulating steel-plate door and magazine door





Figure 9. Small-training aid

**Table 2. List of Components and Weights of Small Training Aid Simulating the Cross Section of Steel-Plate Doors**

| Assembled Part                   | Weight (lb)  |
|----------------------------------|--------------|
| Table                            | 82.0         |
| I-beam Shelf with Nuts and Bolts | 54.8         |
| Plates and I-beams               | 224.2        |
| Total                            | <b>361.0</b> |

## Consumable Parts

The training aids were designed to enable easy replacement of the components that are cut. The size of the plate steel was chosen so that standard sizes of sheet plate procured from a metal supplier could be cut with minimal waste. The pin diameter is a standard bar stock size so that it can be ordered directly from steel suppliers and cut to length. The hasps, simulated hinges, and lock shrouds require fabrication. However, they can be made inexpensively at most machine shops. The consumable parts are listed in Table 3 along with their weights, approximate cost for each, and cost/unit weight.

**Table 3. Consumable Parts**

| Part                              | Weight<br>(each, lb) | Cost<br>(each, \$) | Specific Cost<br>(\$/lb) |
|-----------------------------------|----------------------|--------------------|--------------------------|
| 5/8-inch steel plate, 24x19       | 82.7                 | 25.35              | 0.31                     |
| 3/8-inch steel plate, 24x19       | 49.6                 | 15.27              | 0.31                     |
| 16 gage steel plate, 24x19        | 8.6                  | 3.06               | 0.36                     |
| 1 3/8-inch diameter steel rod x 6 | 2.6                  | 1.53               | 0.59                     |
| S8-23 I-beam, 24 inches long      | 46.0                 | 17.05              | 0.37                     |
| Hinges                            | 2.9                  | 11.31              | 3.90                     |
| Hasps                             | 5.8                  | 10.72              | 1.85                     |
| Left and Right Lock Shroud        | 11.2                 | 24.50              | 2.20                     |
| U-bolts                           | 0.6                  | 2.08               | 3.47                     |
| 1/2-13 nuts                       | 0.02                 | 0.07               | 3.38                     |
| 3/8-16 Bolts x 3 inches           | 0.10                 | 0.30               | 2.88                     |
| 3/8-16 Bolts x 1 1/4 inches       | 0.05                 | 0.13               | 2.40                     |
| 3/8-16 Nuts                       | 0.02                 | 0.05               | 2.69                     |
| 3/8 Washers                       | 0.01                 | 0.07               | 4.72                     |
| Thread Protectors                 | 0.03                 | 0.62               | 22.10                    |

## Summary

A training aid was designed and fabricated to simulate features of magazine and steel-plate doors. The training aid will help breachers practice using their tools on realistic components and then allow easy replacement of the components.



## **Appendix A: Assembly Instructions for Small Training Aid**

### **Description**

The small training was designed to simulate the cross section of steel-plate and magazine doors. Figure A-1 shows this fixture. It was designed for quick replacement of consumable parts. Consumable parts are those designed to be damaged/destroyed during training exercises.



Figure A-1. Assembled small training aid

### **Assembly Instructions**

Assembly involves putting together the supports and attaching them to the table, then installing the plates. Begin by locating all parts and tools necessary for assembly and placing table upright.

### **Tools Required**

Two adjustable wrenches or two 9/16-inch wrenches

## Supports

1. To simulate magazine doors, slip the magazine plate supports (part #16) through the all-thread bolts of the vertical C-channels (part #3) and skip steps two and three.
2. For steel plate doors, align the I-beam support plate (joined parts #9 and #14) with parallel holes in flat face of part #3. Ensure that the angle iron is in a downward orientation.
3. Push bolt ( $\frac{3}{8}$ -inch diameter, 1 $\frac{1}{4}$ -inch long) through hole in angle iron and C-channel and thread into nut; tighten until structure is straight and secure. Repeat on other side. Stand should resemble Figure A-2 when completed.
4. Align slots in plate (part #4) with holes in the tabletop. C-channels should be facing away from each other and toward respective edges of plate. [Part #4 should be parallel to the holes in the table (part #1)].
5. Push bolt (part #6) through washer, plate (part #4), and desired hole in the table (part #1) (the fifth and seventh holes from the edge). Continue through another washer, and thread into nut. Tighten by hand until I-beam shelf is straight and secure (for steel-plate doors only).
6. Overall structure should resemble Figure A-3 up to this point, except for the insertion of consumable plates.

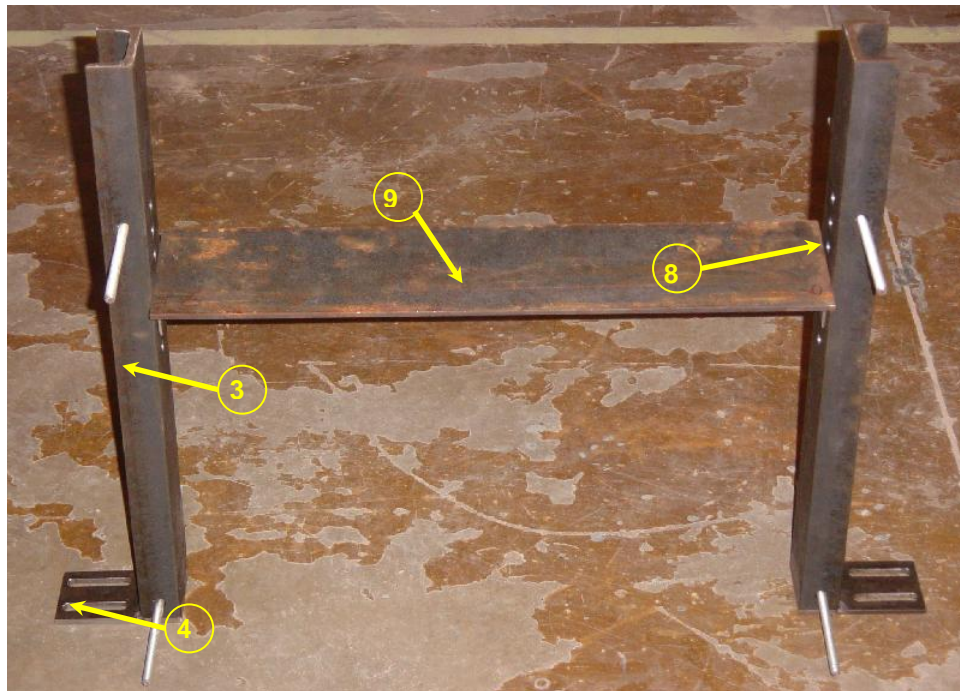


Figure A-2. I-beam shelf for steel plate doors

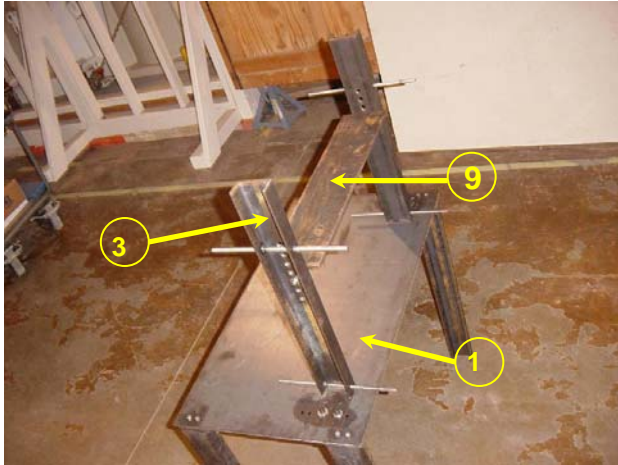


Figure A-3. Supports mounted to table: (left) for steel plate doors, (right) for magazine doors

### ***Plate Attachment***

1. To simulate magazine doors skip this step. Secure I-beam shelf onto table top (part #1), as discussed in the previous section. Rest one I-beam on the table (part #1) between the C-channel (part #3). The bolts securing the I-beam shelf to the C-channels (part #3) and to the table may need to be loosened to fit the I-beam into place. Place another I-beam on the shelf (part #9). Ensure that part #3 is as flush as possible with I-beams and then secure fixture to the table.
2. Place the desired plates (use  $\frac{5}{8}$ -inch- and  $\frac{3}{8}$ -inch-thick plates (parts #10 and #11) for steel-plate doors or  $\frac{3}{8}$ -inch- and 16-gage-thick plates for magazine doors (parts #11 and #17) flush with sides of the I-beams for steel-plate doors, or flush with magazine support plate (part #16) for magazine doors.
3. Insert angle iron (part #5) for steel-plate doors or another magazine support plate (part #16) for magazine doors through the all-thread rods to secure the plates.
4. Thread the wing nuts in all four locations until plates are secured into desired positions. Place thread protectors (Figure A-4) over all-thread rods to keep slag from getting on threads. Overall structure should resemble Figure A-5 for large steel-plate doors or Figure A-6 for magazine doors.





Figure A-4. Thread protectors to prevent slag buildup on threads



Figure A-5. Small training aid setup for steel-plate doors



Figure A-6. Small training aid setup for magazine doors

### ***Replacing Consumable Parts***

Once the fixture is assembled, it is ready to be used for training. After a breacher has destroyed the plates, then they can be replaced prior to training use again. This will include:

1. Remove any slag that could inhibit disassembly. Unscrew wing nuts in all four locations until cut plates can be removed and disposed of properly.
2. Insert new plates into same location as the previous plates and ensure that associated angle iron or magazine support plate is correctly aligned.
3. Tighten wing nuts in all four locations until plates are secured into desired positions.

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## Appendix B: Assembly Instructions for Large Training Aid

### Description

The large training aid was designed to simulate features on steel-plate and magazine doors. This fixture simulates door features that may need to be breached (hinges, hasps, locks, pins, lock shrouds). This fixture was designed to allow for repeated use by several trainees and for quick removal and attachment of consumable parts. Consumable parts are those designed to be damaged/destroyed during training exercises. This fixture can be disassembled for easy shipment. Figure B-1 shows the assembled fixture, and Figure B-2 is a drawing of the side view.



Figure B-1. Assembled large training aid

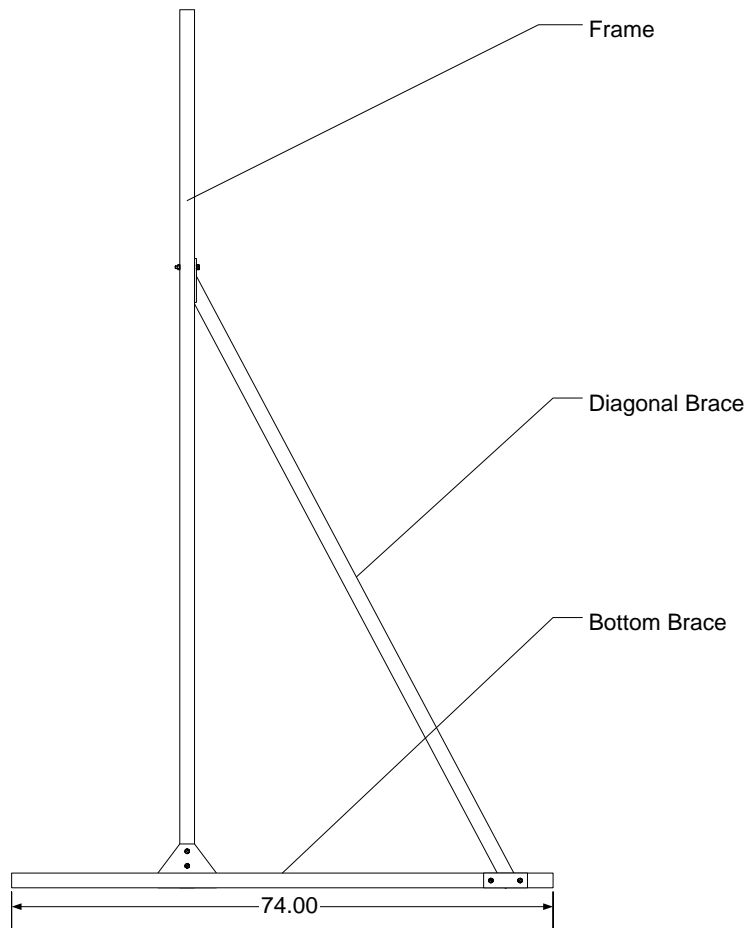


Figure B-2. Side view of large training aid

The fixture will be shipped with the major subassemblies built, but will require the bottom brace, diagonal brace, and pins to be attached. Assembly of these components is described below:

### **Tools Required**

1. Two adjustable wrenches or two 9/16-inch wrenches
2. Tag line

### **1) Attach Lower Braces**

Lay the frame on the ground between the two bottom braces, aligning the bottom holes. Note the 2" x 2" box beam of the bottom brace goes to the outside of the fixture. Attach a washer and then slide a 3-inch long bolt through the bottom hole in the plate of the bottom brace and the bottom hole in the box beam of the frame. Attach another washer, then thread in a nut, but do not tighten it yet. This will be a pivot. Repeat for the other bottom brace. The fixture should look like Figure B-3 at this point.



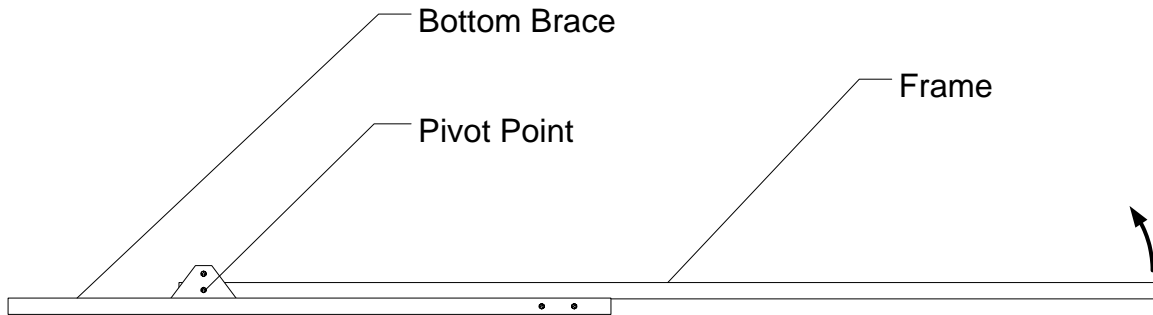


Figure B-3. Frame attached with bolt to lower hole in plate of bottom brace

## **2) Attach Diagonal Braces**

Pivot the frame upward until it is vertical. It will help to have a tag line attached to the top pin holder so that the top can be pulled upward. Pivoting the frame upward may require four persons: one pulling on the tag line, one on each side, and one providing additional support. While holding the frame vertically, one person inserts a 3-inch bolt with washer through the remaining hole in the plate on the bottom brace and through the vertical box beam of the frame (Figure B-4). Attach another washer and nut to the bolt. Next, attach the diagonal braces. Each diagonal brace requires a 3-inch bolt with a washer on each side and a nut to attach it to the frame (Figure B-5) and two 3-inch bolts with washers and nuts to attach it to the lower brace (Figure B-6). Tighten all bolts on the frame.



Figure B-4. Bottom brace attached to frame



Figure B-5. Diagonal brace attached to frame



Figure B-6. Diagonal brace attached to bottom brace

### **3) Insert Pins**

The pins simply slide into the holes in the upper and lower pin holders (Figure B-7). The upper and lower pin holders can each hold six pins.



Figure B-7. Pins in lower pin holder



## ***Replacing Consumable Parts***

### **Pins:**

1. When the pins (1¾-inch steel rods) have been cut during training, remove them by pulling vertically out of retainer holes. (This may require further effort due to slag buildup.)
2. Replace pins by lowering pins vertically into retainer holes.

### **Door Locking Hasps:**

1. When hasps or U-bolts have been cut, begin by removing nuts securing U-bolts.
2. Remove U-bolts and hasps.
3. Attach the two nuts on each end of the eight U-bolts (partway).
4. Slide a U-bolt through the 1-inch diameter hole in the hasp, and then slide the U-bolt through the two holes on the left side of the rectangular slot.
5. Attach nuts to secure it to the plate.
6. Attach another U-bolt to the two holes on the right side of the rectangular slot (Figure B-8).



Figure B-8. Hasps

### Hinge:

1. When hinge has been cut remove by unscrewing  $\frac{3}{8}$ -inch diameter bolt.
2. Replace hinge and secure with bolt, washers, and nut. See Figure B-9.



Figure B-9. Hinges

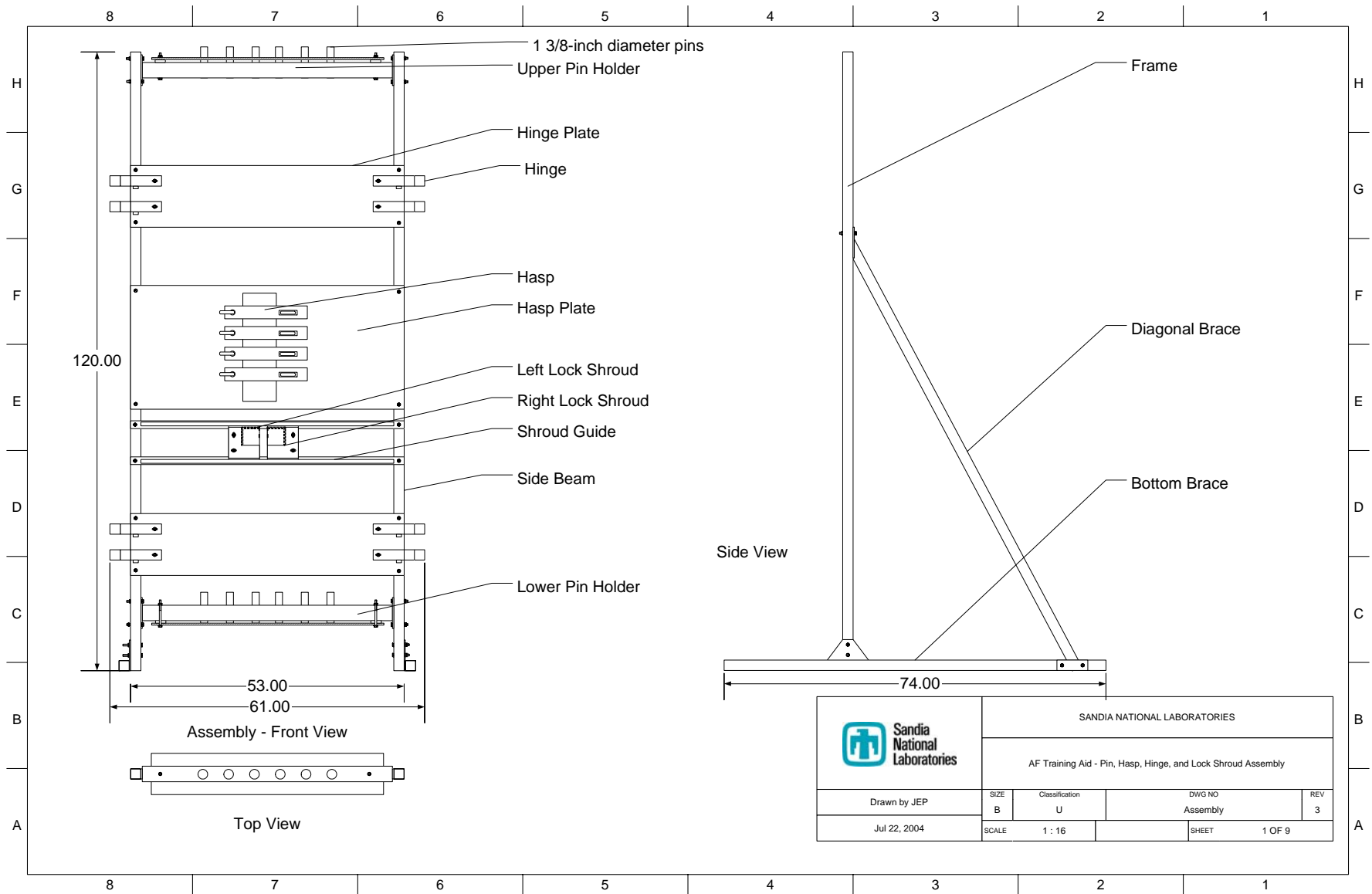
### Lock Shrouds:


1. When the left or right lock shroud has been cut, remove by unscrewing securing bolts.
2. Replace the shroud and adjust it so it fits with the other shroud before tightening the bolts. See Figure B-10.

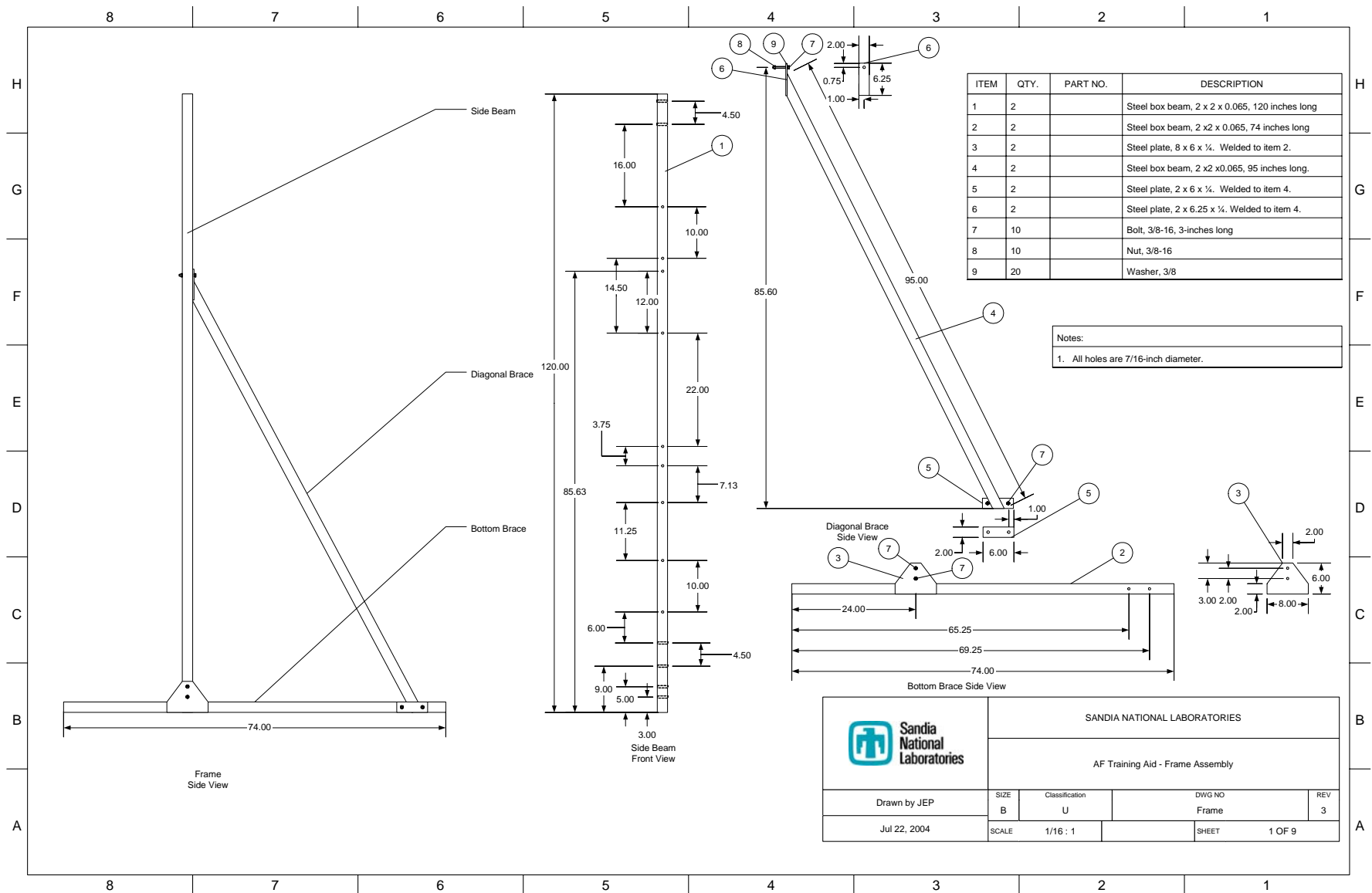


Figure B-10. Lock shroud

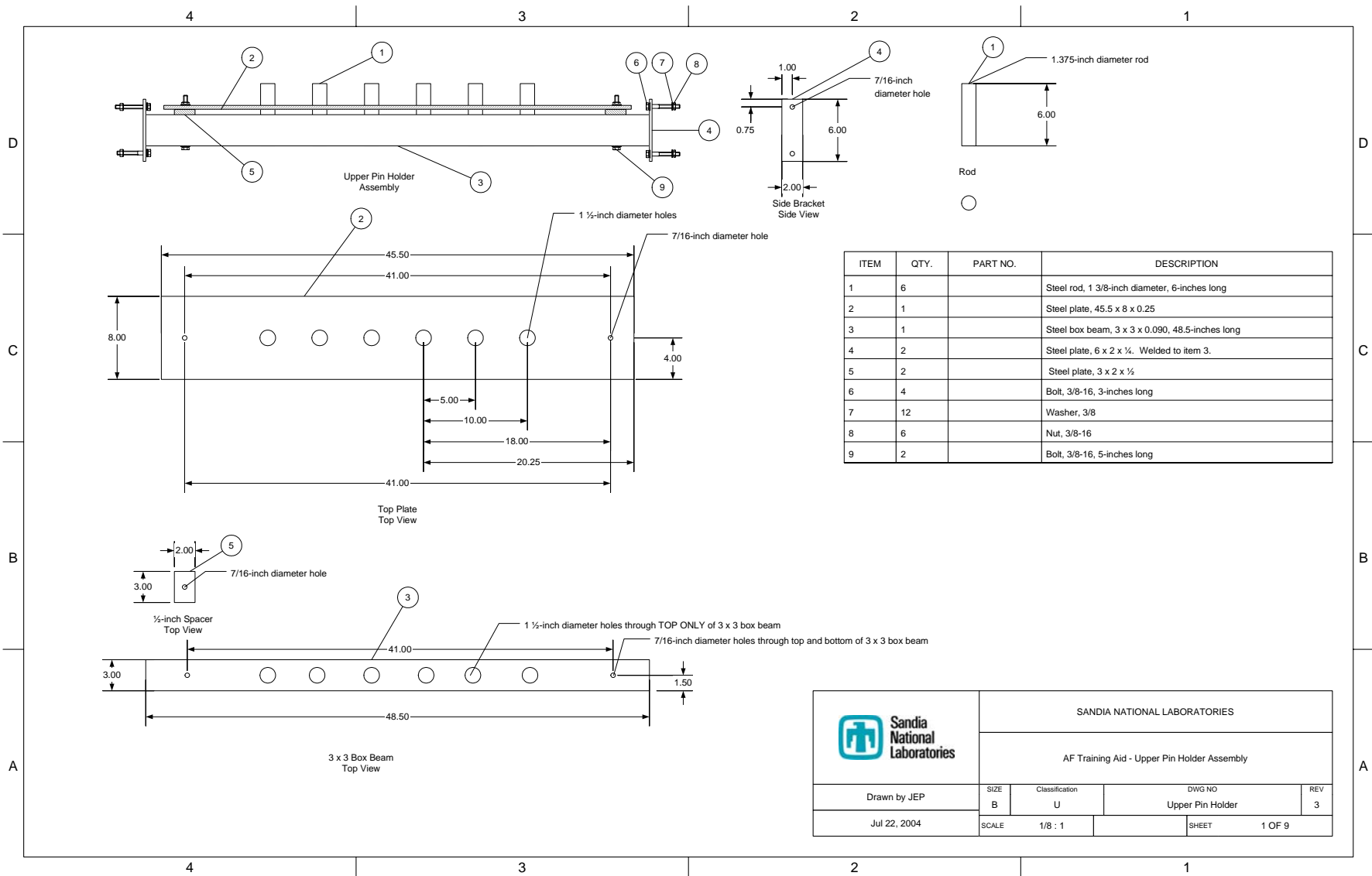
# Appendix C: Fixture Drawings

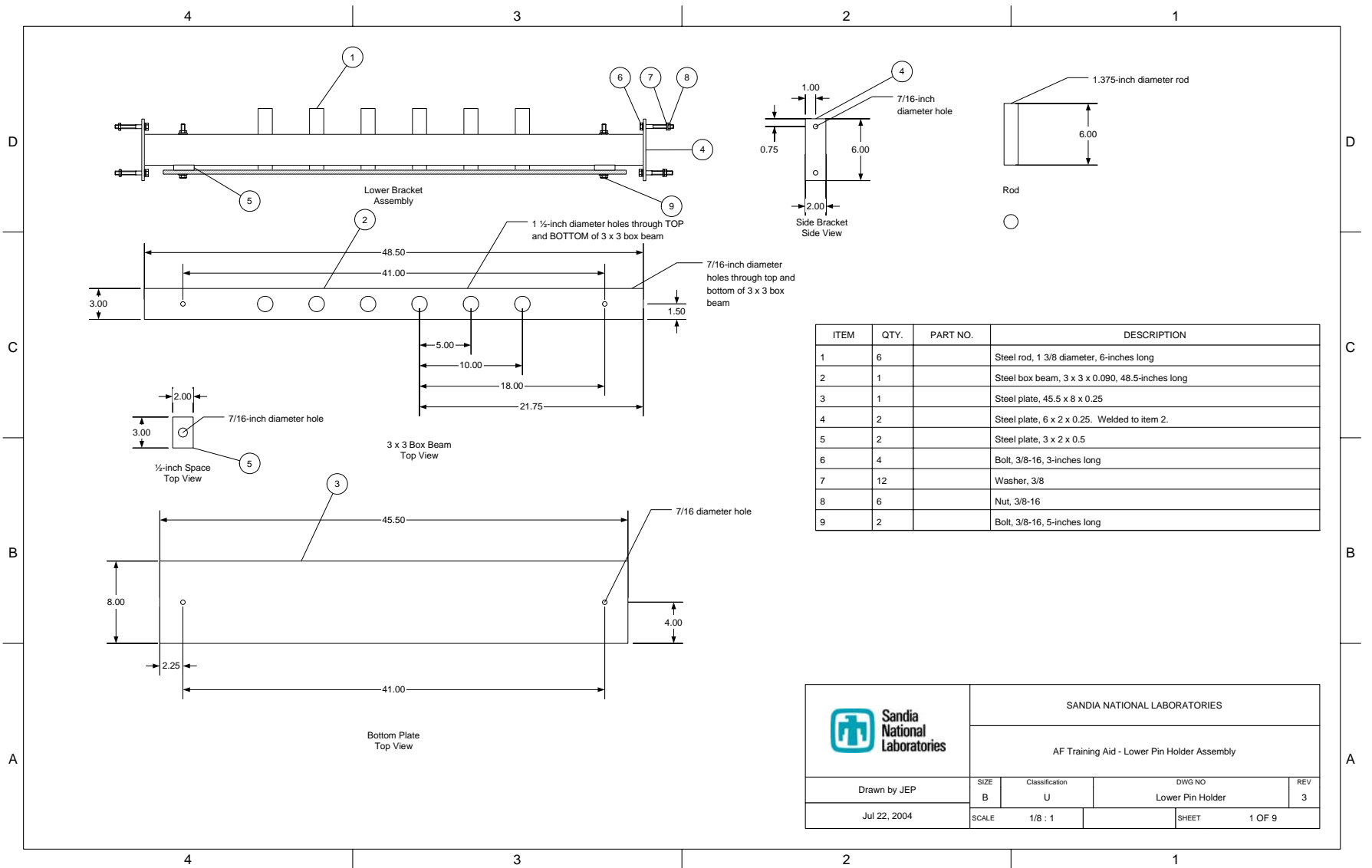


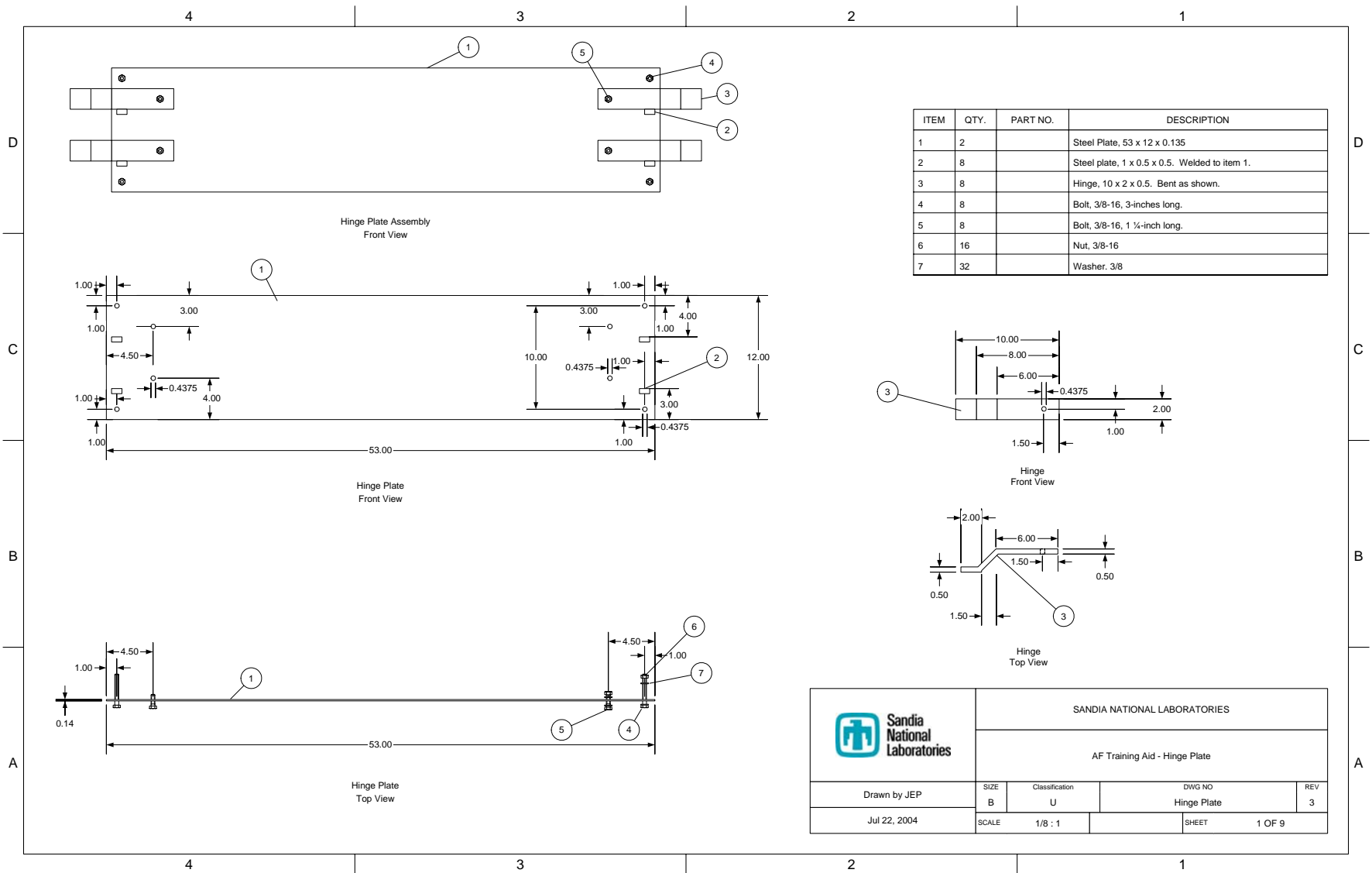
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|  Sandia National Laboratories | SANDIA NATIONAL LABORATORIES                                 |                     |                    |          |
|  | AF Training Aid - Pin, Hasp, Hinge, and Lock Shroud Assembly |                     |                    |          |
| Drawn by JEP   | SIZE<br>B  | Classification<br>U | DWG NO<br>Assembly | REV<br>3 |
| Jul 22, 2004   | SCALE  | 1 : 16              | SHEET              | 1 OF 9   |



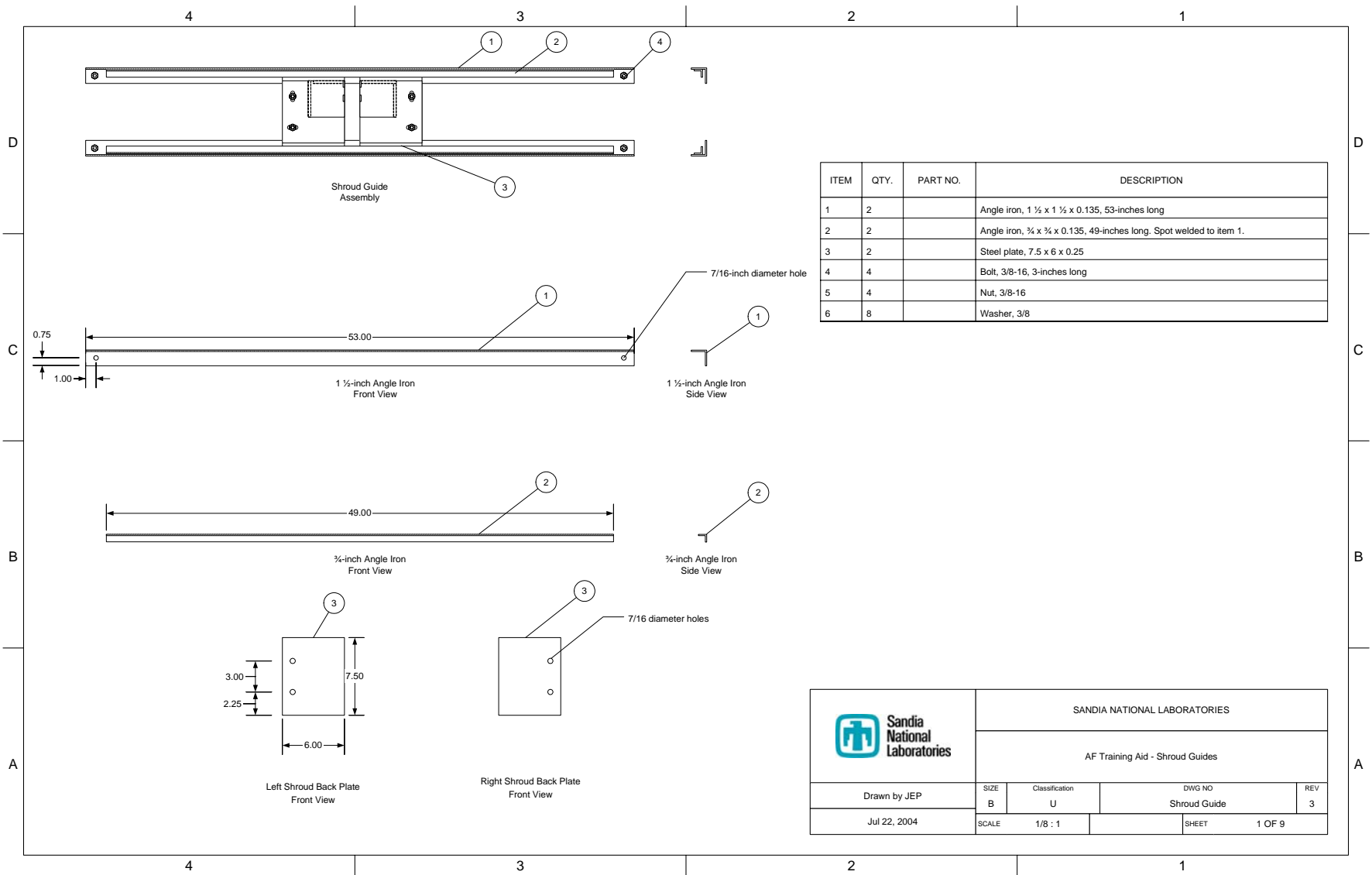


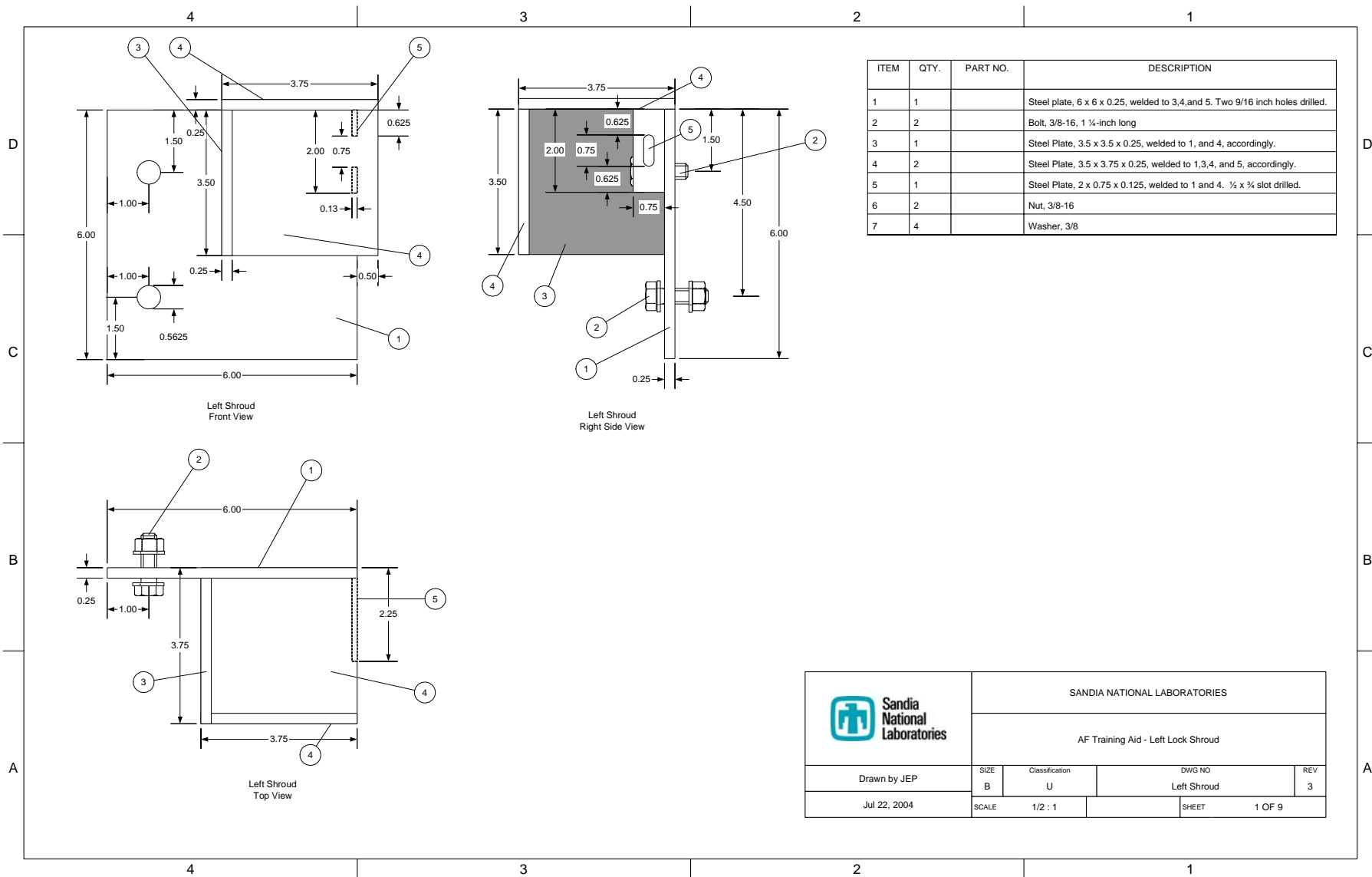


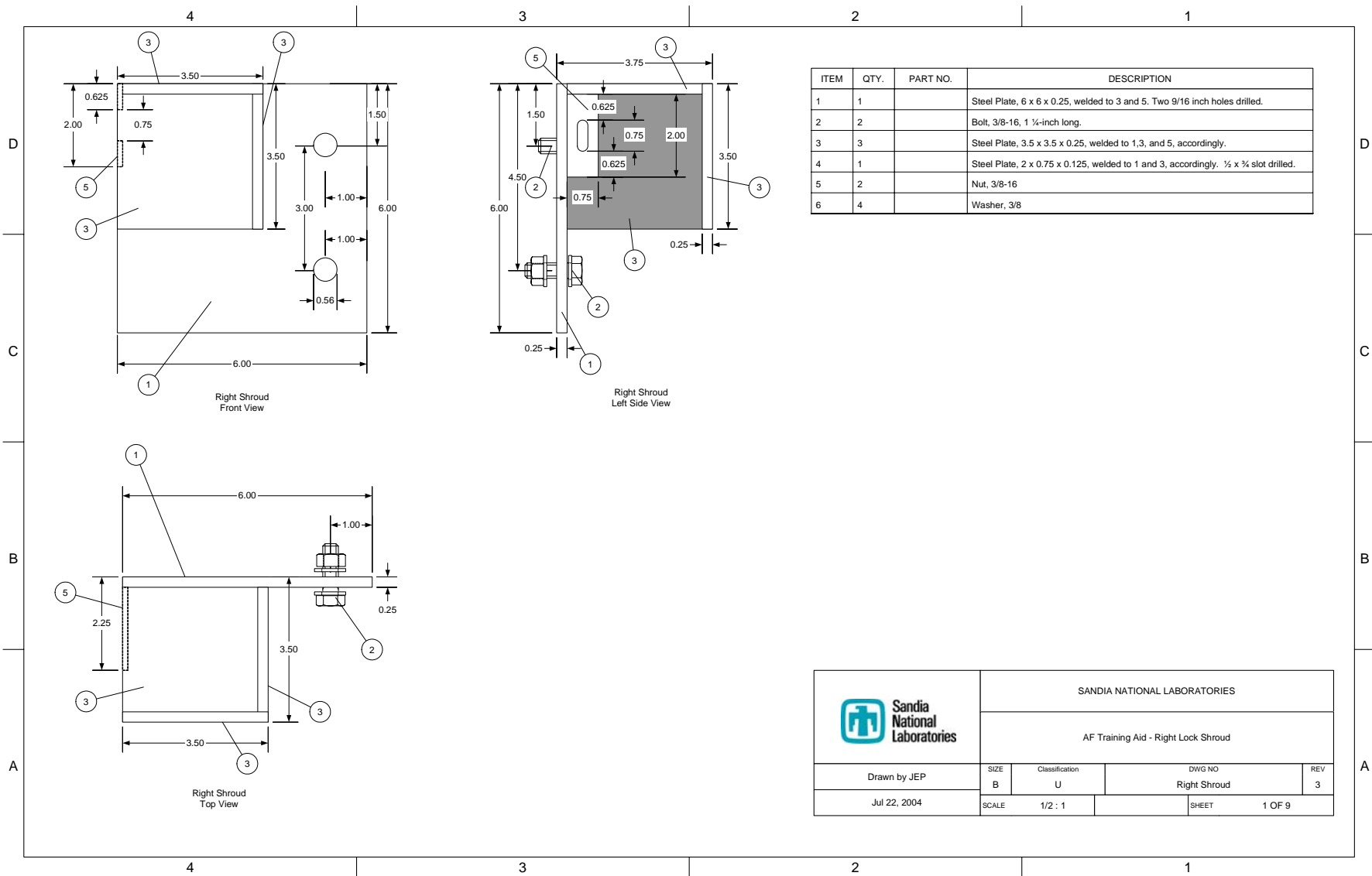


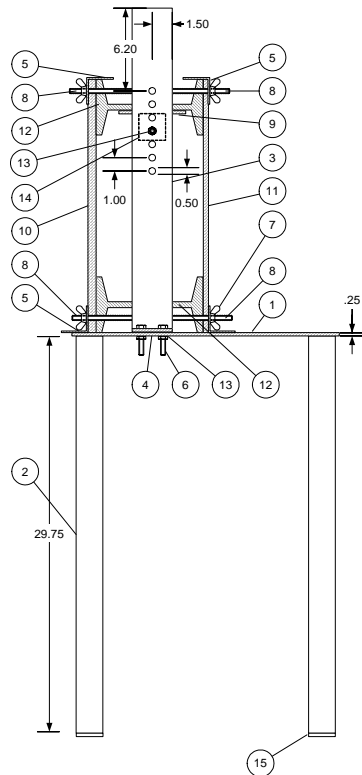
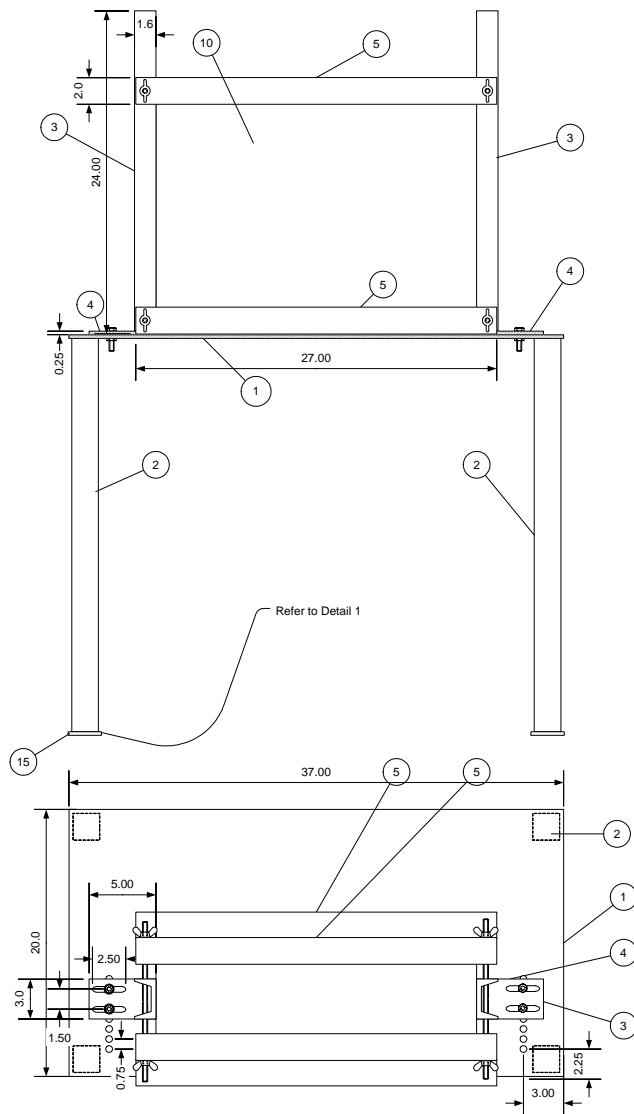




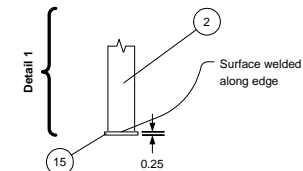









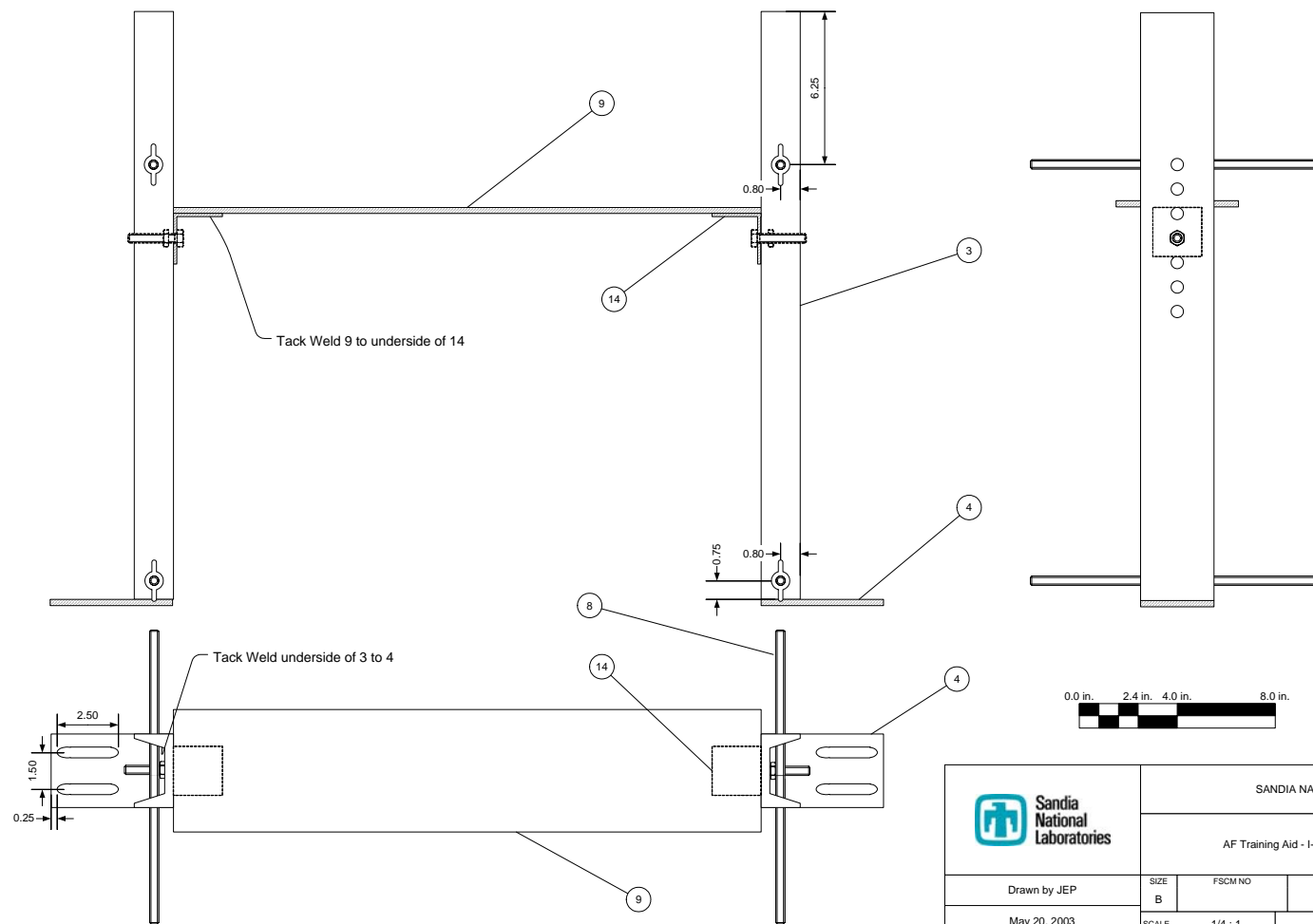
| ITEM | QTY. | PART NO. | DESCRIPTION  |
|------|------|----------|--|
| 1    | 1    |          | Steel Plate, 37 x 20 x 0.25, welded to 2. Several 7/16-inch holes drilled. |
| 2    | 4    |          | Steel Box Beam, 2 x 2 x 0.065, 29.75 inches long, welded to 1              |
| 3    | 2    |          | C3 x 6 x 24 inches long, steel, welded to 4, See page 2 for details        |
| 4    | 2    |          | Steel Plate, 5 x 3 x 0.25 welded to 3, See page 2 for details              |
| 5    | 4    |          | Angle iron, 2 x 2 x 0.125, 27 inches long                                  |
| 6    | 6    |          | Bolt, 3/8-16, 2 inches long  |
| 7    | 4    |          | Wing nut, 3/8-16   |
| 8    | 8    |          | All-Thread Bolt, 3/8-16, 12 inches long, welded inside of 3                |
| 9    | 1    |          | Steel plate, 5 x 24 x 0.25   |
| 10   | 1    |          | Steel plate, 24 x 19 x 0.625   |
| 11   | 1    |          | Steel plate, 24 x 19 x 0.375   |
| 12   | 2    |          | I-Beam, S8 x 23, 24 inches long, steel                                     |
| 13   | 6    |          | Nut, 3/8-16  |
| 14   | 2    |          | Angle iron, 2 x 2 x 0.125, 2 inches long. See page 2.                      |
| 15   | 4    |          | Steel Plate, 2.5 x 2.00 x .25, welded to 2.                                |




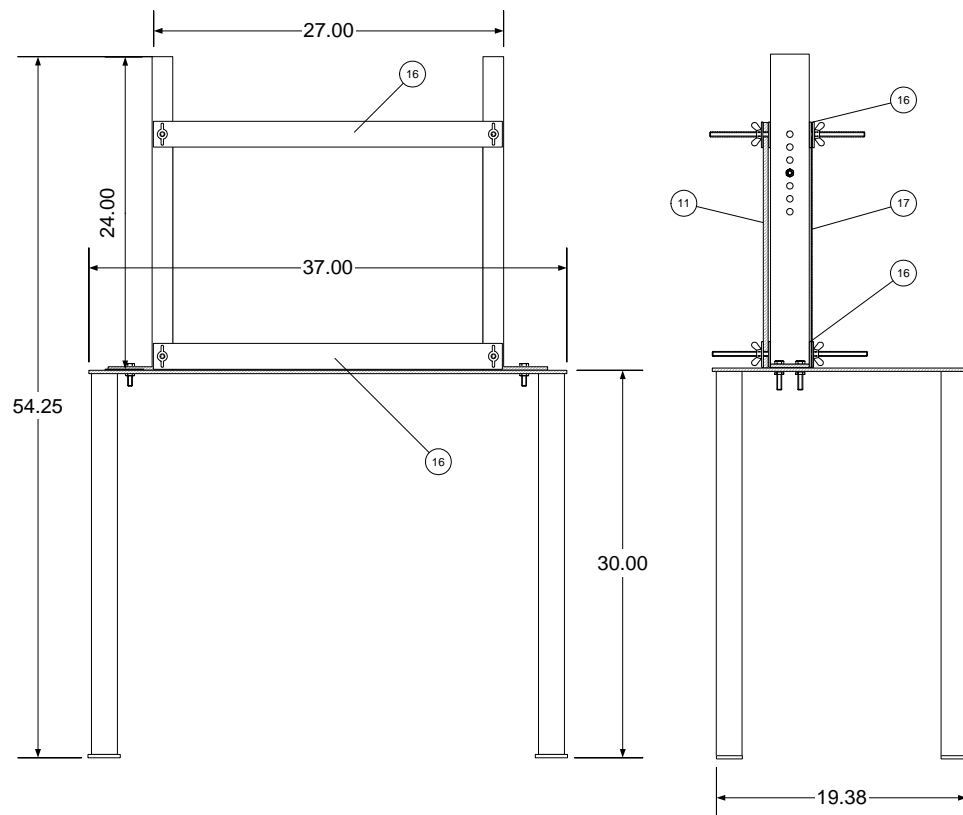
**Door Cross-Section Simulator**  
**Steel Plate Door Shown**

|   |                  |  |                                  |          |  |
|---|------------------|--|----------------------------------|----------|--|
|  |                  | SANDIA NATIONAL LABORATORIES                   |                                  |          |  |
|   |                  | AF Training Aid - Door Cross-Section Simulator |                                  |          |  |
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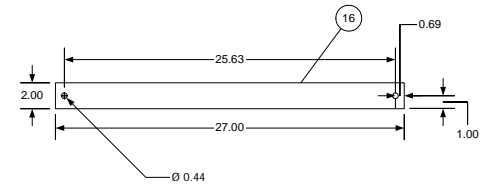





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|---|-----------|---------|-----------------|----------|
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| SANDIA NATIONAL LABORATORIES  |           |         |                 |          |
| AF Training Aid - I-Beam Shelf for Steel Plate Doors  |           |         |                 |          |
| Drawn by JEP  | SIZE<br>B | FSCM NO | DWG NO<br>Shelf | REV<br>0 |
| May 20, 2003  | SCALE     | 1/4 : 1 | SHEET           | 1 OF 3   |



| ITEM | QTY. | PART NO. | DESCRIPTION   |
|------|------|----------|---|
| 16   | 8    |          | Steel plate, 27 x 2 x 0.125, with two 7/16 diameter holes |
| 17   | 1    |          | Steel plate 24 x 19, 16 gage thick                        |



|   |           |                                       |  |          |        |
|---|-----------|---------------------------------------|--|----------|--------|
|  |           | SANDIA NATIONAL LABORATORIES          |  |          |        |
|   |           | AF Training Aid - Magazine Door Setup |  |          |        |
| Drawn by JEP  | SIZE<br>B | FSCM NO.                              | DWG NO.<br>Cross-Section Assembly      | REV<br>0 |        |
| Jul 23, 2004, 13:55   | SCALE     | 1/8 : 1                               | Revised Door Cross-Section Fixture.vsd | SHEET    | 1 OF 3 |

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